Influence of microorganisms on the integrity of marine structures

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Several seawater parameters e.g., physico-chemical, hydrodynamics and in particular biological ones can greatly affect the integrity and performances of marine structures.

Two microbial issues responsible for major safety and economic losses in the maritime sector are *Biofouling* (i.e., the built-up of micro- and macro-organisms on surfaces), leading to e.g. coating degradation, decreased power efficacy and *Microbiologically Influenced Corrosion* (MIC), leading to premature steel perforation phenomena.

Localized accelerated corrosion (>0,4 mm/year/side) due to MIC have been experienced on marine structures few centimetres to few meters below to the low water line e.g., on harbour infrastructures, ballast tanks, inner foundations of monopiles offshore wind turbines [1, 2, 3]. This phenomenon referred as Accelerated Low Water Corrosion (ALWC) within seaport has been investigated worldwide and linked to environmental pollution (e.g. nutrient inputs, (algal) biomass proliferation), low water renewal and macro-cells interfaces formed along steel structures by differential aeration (e.g., tidal/immersion and immersion/sediment zones) [4, 5]. Studies on the diversity and activity of microbial communities associated with sheet pilings affected or not by accelerated corrosion in the low water zones revealed that the co-existing metabolic activity of specific sulfate-reducing bacteria (SRB) within the *Desulfobulbaceae* family and heterotrophic sulfur/iron oxidizing bacterial (SOB/IOB) species associated with porous and electroconductive minerals, facilitating mass and electron transfers through the deposit layers, were key markers of ALWC.

Experimental simulation of MIC in e.g., the low water and sediment zones proved to be a current promising support tool in MIC management. Namely, simulation experiments showed a direct causal role of EMIC (Electrical MIC) microbial species (up-taking electrons directly from Fe (0)) in the accelerated corrosion rates, not considered in current MIC assessment and management tools [6, 7].

Likewise, recent findings indicate that efficient Biofouling management strategies should focus on the identification of key factors/molecules controlling the adhesion, diversity and activity of pioneer microbial communities on surfaces (microfoulers), rather than macrofoulers, which settlement strongly depends on the formers [8]. On-going development of experimental dedicated platforms is enabling such research.

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